3. Suppose the price elasticity of demand for heating oil is 0.2 in the short run and 0.7 in the long run.

   a. If the price of heating oil rises from $1.80 to $2.20 per gallon, what happens to the quantity of heating oil demanded in the short run? In the long run? (Use the midpoint method in your calculations.)

   b. Why might this elasticity depend on the time horizon?

(a) Midpoint elasticity : $\eta_D = \dfrac{\left.\dfrac{(Q_1 - Q_0)}{(Q_1 + Q_0)/2}\right\} \%\Delta Q_d}{\left.\dfrac{(P_1 - P_0)}{(P_1 + P_0)/2}\right\} \%\Delta P}$

=> Price rises from $1.8 to $2.2. It means that $\%\Delta P = \dfrac{2.2 - 1.8}{\frac{(2.2+1.8)}{2}} = 20\% = 0.2$

- In short run : $\eta_D = \dfrac{\%\Delta Q_d}{\%\Delta P}$ => $-0.2 = \dfrac{\%\Delta Q_d}{0.2}$ => $\%\Delta Q_d = -0.04 = -4\%$

  So, in short run, quantity demanded decreases by 4 %. #

- In long run : $\eta_D = \dfrac{\%\Delta Q_d}{\%\Delta P}$ => $-0.7 = \dfrac{\%\Delta Q_d}{0.2}$ => $\%\Delta Q_d = -0.14 = -14\%$

  In long run, quantity demanded will decrease by 14 % #

(b) Long-run price elasticity is higher because consumers have more time to react and find alternative source of energy to substitute for the heating oil.

7. Suppose that your demand schedule for pizza is as follows:

| Price | Quantity Demanded (income = $20,000) | Quantity Demanded (income = $24,000) |
|---|---|---|
| $8 | 40 pizzas | 50 pizzas |
| 10 | 32 | 45 |
| 12 | 24 | 30 |
| 14 | 16 | 20 |
| 16 | 8 | 12 |

a. Use the midpoint method to calculate your price elasticity of demand as the price of pizza increases from $8 to $10 if (i) your income is $20,000 and (ii) your income is $24,000.

b. Calculate your income elasticity of demand as your income increases from $20,000 to $24,000 if (i) the price is $12 and (ii) the price is $16.

(a) Midpoint elasticity : $\eta_D = \dfrac{\underbrace{\dfrac{(Q_1 - Q_0)}{(Q_1 + Q_0)/2}}_{\% \Delta Q_d}}{\underbrace{\dfrac{(P_1 - P_0)}{(P_1 + P_0)/2}}_{\% \Delta P}}$

(i) income = $20,000

=> When price increases from $8 to $10, price increases by $\dfrac{10-8}{\frac{(10+8)}{2}} = 0.2222 = 22.22\%$

=> So, $Q^d$ changes from 40 to 32, $Q^d$ decreases by $\dfrac{32-40}{\frac{(32+40)}{2}} = -0.2222 = -22.22\%$

Therefore, $\eta_D = \dfrac{\% \Delta Q}{\% \Delta P} = \dfrac{-22.22}{22.22} = -1$ (unit elastic) #

(2) income = $24,000

=> When price increases from $8 to $10, price increases by $\dfrac{10-8}{\frac{(10+8)}{2}} = 0.2222 = 22.22\%$

=> So, $Q^d$ changes from 50 to 45, $Q^d$ decreases by $\dfrac{45-50}{\frac{(45+50)}{2}} = -0.1053 = -10.53\%$

Therefore, $\eta_D = \dfrac{\% \Delta Q}{\% \Delta P} = \dfrac{-10.53}{22.22} = -0.4739$ (inelastic) #

(b) $\eta_I = \dfrac{\%\Delta Q_d}{\%\Delta I}$

=> Income increases from \$20,000 to \$24,000. $\%\Delta I = \dfrac{24000-20000}{20000} \times 100 = 20\%$

- (i) price = \$12

=> $Q_d$ increases from 24 to 30. $\%\Delta Q_d = \dfrac{30-24}{24} \times 100 = 25\%$

Therefore, $\eta_I = \dfrac{\%\Delta Q_d}{\%\Delta I} = \dfrac{25}{20} = 1.25$ ( Luxury goods ) #

- (ii) price = \$16

=> $Q_d$ increases from 8 to 12. $\%\Delta Q_d = \dfrac{12-8}{8} \times 100 = 50\%$

Therefore, $\eta_I = \dfrac{\%\Delta Q_d}{\%\Delta I} = \dfrac{50}{20} = 2.5$ ( Luxury goods ) #